# Table of Contents


| | | Page |
|---|---|---|
| PREFACE | | v |
| CHAPTER 1. | ABSTRACT EXISTENCE AND UNIQUENESS RESULTS FOR SOLUTIONS OF VARIATIONAL INEQUALITIES | 1 |
| | 1.1. Fixed Point Theorems | 1 |
| | 1.2. Motivation | 1 |
| | 1.3. Existence and Uniqueness Results | 3 |
| | Comments | 9 |
| CHAPTER 2. | EXAMPLES AND APPLICATIONS | 10 |
| | 2.1. Some Functional Analysis | 10 |
| | 2.2. The Dirichlet Problem | 14 |
| | 2.3. The Obstacle Problem | 16 |
| | 2.4. Elastic Plastic Torsion Problems | 17 |
| | 2.5. Nonlinear Operators | 18 |
| | 2.6. Fourth Order Variational Inequalities | 20 |
| | Comments | 21 |
| CHAPTER 3. | THE OBSTACLE PROBLEMS: A REGULARITY THEORY | 22 |
| | 3.1. Monotonicity Results | 22 |
| | 3.2. The Penalty Method | 24 |
| | 3.3. $W^{2,p}(\Omega)$-Regularity $(2 \leq p < +\infty)$ | 27 |
| | 3.4. Some Complementary Results | 30 |
| | 3.5. $W^{2,\infty}(\Omega)$-Regularity | 33 |
| | 3.6. $W^{1,\infty}(\Omega)$-Regularity | 50 |
| | 3.7. $W^{1,p}(\Omega)$-Regularity $(2 < p < +\infty)$ | 60 |
| | Appendix. $L^p$-Estimates for the Solution of the Dirichlet Problem | 67 |
| | Comments | 73 |
| CHAPTER 4. | THE DAM PROBLEM | 74 |
| | 4.1. Statement of the Problem | 74 |
| | 4.2. Some Properties of $(p,\chi)$ Solution of (P) | 82 |
| | 4.3. $S_3$-Connected Solutions | 90 |
| | 4.4. Uniqueness of $S_3$-Connected Solutions | 101 |
| | 4.5. Some Monotonicity Results for the Free Boundary | 106 |
| | Comments | 110 |
| REFERENCES | | 111 |
| INDEX | | 117 |